



*Best Management Practices  
for  
Golf Course Maintenance Departments*

Florida Department  
of  
Environmental Protection  
Agricultural Source and Water Well Management Section

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## **Best Management Practices for Golf Course Maintenance Departments**

### **Introduction**

The maintenance department is responsible for irrigation, mowing, fertilization, pesticide application and general upkeep of the golf course grounds. The maintenance area is where pesticides are loaded into application equipment, mowers and other pieces of equipment are serviced, and pesticides, fuel, fertilizer, and cleaning solvents are stored.

This is where pollution of soil, surface water, or ground water is most likely to occur. Contamination can occur when pesticides are spilled, containers or equipment cleaned and the rinsewater dumped on the ground or discharged into surface water, or improperly cleaned containers are stockpiled or buried. Proper management of the maintenance area is an important part of responsible chemical and pesticide use. Poor handling and disposal practices at these sites can lead to serious environmental problems, expose the ownership to extensive legal liability for contamination and cleanup, including penalties and fines, and can create a poor public image for the golf course.

Management practices should be implemented at these maintenance areas that will prevent the contamination of soil, surface water, and ground water by the materials stored and handled at these sites. This document describes a number of "Best Management Practices", or BMPs, which can be put into practice through proper design and operation of the golf course maintenance facilities and equipment.

### **Best Management Practice Principles**

The general approach to best management practices for golf course maintenance departments involves three principles :

- ✂ Isolate all potential contaminants from soil and water, and,
- ✂ Do not discharge any material other than clean stormwater onto the ground or into surface water bodies.
- ✂ Minimize irrigation, fertilizer, and pesticide use requirements through use of Integrated Pest Management and native or naturalized vegetation wherever practicable.

The first principle involves identifying all the materials stored or handled in a golf course maintenance area along with current practices that could cause environmental contamination. The next step is to develop management practices which isolate those materials from soil and water during storage, handling, and disposal. Materials that may contaminate soil and water include pesticides, fuels, solvents, fertilizers, paints,

etc. Storing these materials in covered, lockable storage areas, handling them over impermeable surfaces, cleaning up spills promptly and properly, recycling these materials where possible, and otherwise properly managing wastes will keep these materials from contaminating soil or water.

The second principle is an extension of the first. It includes preventing contamination of stormwater and eliminating the discharge of materials such as equipment wash water to ground or surface waters. Discharge to surface waters can occur directly through dumping to a lake or canal, or indirectly through discharge to a ditch, storm drain or swale. Discharge to ground water may occur by percolation through highly permeable soils, such as the fine sandy soils found in much of Florida, or by flowing into sinkholes, improperly constructed wells or other direct conduits to ground water. Discharges to surface or ground water should be eliminated through the containment and collection of equipment washwaters and proper management of the collected material. Where allowed by the local Department of Environmental Protection (DEP) District office or local authorities, stormwater, and washwater other than that from pesticide application equipment, may be discharged to a swale or retention area that does not connect to a surface water body or provide a direct conduit to the ground water.

Several specific BMPs for golf course maintenance areas are described below which comply with these two general principles. If a material handled or a maintenance practice employed at a golf course maintenance area is not addressed below, golf course managers can use these principles to devise their own BMP for that activity or material.

The third principle, that of minimizing fertilizer, pesticide and irrigation use through use of native vegetation and Integrated Pest Management directly impacts the amount of materials handled annually, reduces the annual maintenance budget, and encourages good environmental stewardship. An example of how a golf course owner or operator can obtain assistance in this area is through the Audubon Cooperative Sanctuary Program (ACSP), a program of the Audubon Society of New York State, Inc., sponsored by the the United States Golf Association. This voluntary program offers extensive planning, guidance, and technical assistance while requiring no restrictions on the property. All decisions to act on ACSP suggestions are made by the golf course superintendent and course officials.

### **Specific Best Management Practices**

Specific BMPs for golf course maintenance areas are listed below by the type of material handled or the maintenance activity conducted. These are summarized at the end of this section. Sources for the references provided in each section are detailed at the end of the document.

## **1.0 Pesticides**

### **1.1. Storage**

Storage of pesticides should be in a lockable concrete or metal building, located at least 50 feet from other types of structures to allow fire department access. The pesticide storage area should be separate from other buildings or at least separate from areas used to store other materials, especially fertilizers. Shelving should be plastic or reinforced metal. Metal shelving should be kept painted to avoid corrosion. Wood shelving should never be used because it may absorb spilled pesticide materials.



**Figure 1 Storage and Mix/load facility. Courtesy of Collier's Reserve Country Club, Naples, FL.**

Floors should be seamless metal or concrete and sealed with a chemical-resistant paint. The floor should have a continuous sill to retain spilled materials and it should have no drains, although a sump may be included. Sloped ramps should be provided at the entrance to allow wheeled handcarts to move material in and out of the storage area safely. Automatic exhaust fans and an emergency wash area should be provided.

Explosion proof lighting may be required. It is recommended that the light/fan switch be located outside the building so that both are on when entering or leaving the building. Personal protective equipment should be easily accessible and stored immediately outside of the pesticide storage area. An inventory of the pesticides kept in the storage building and the Material Safety Data Sheets (MSDS) for the chemicals used in the operation should be accessible on the premises, but not kept in the pesticide storage room itself (since that would make them unavailable in time of emergency).

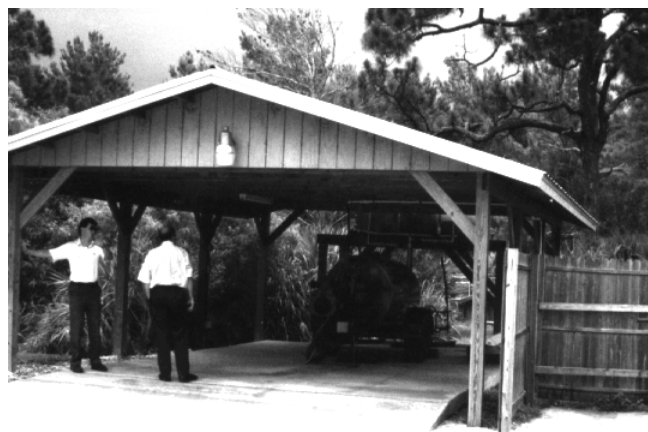
Flammable pesticides should be separated from non-flammable. Dry bags should be raised on pallets to ensure that they do not get wet. Liquid materials should always be stored below dry materials, never above them. Labels should be clearly legible. Herbicides, insecticides and fungicides should be separated to prevent cross contamination and minimize the potential for misapplication. (Since cross contaminated pesticides often cannot be applied in accordance with the labels, this makes it necessary to dispose of the contaminated materials as wastes. This may require the

services of a consultant and hazardous waste contractor, depending on the materials involved.)

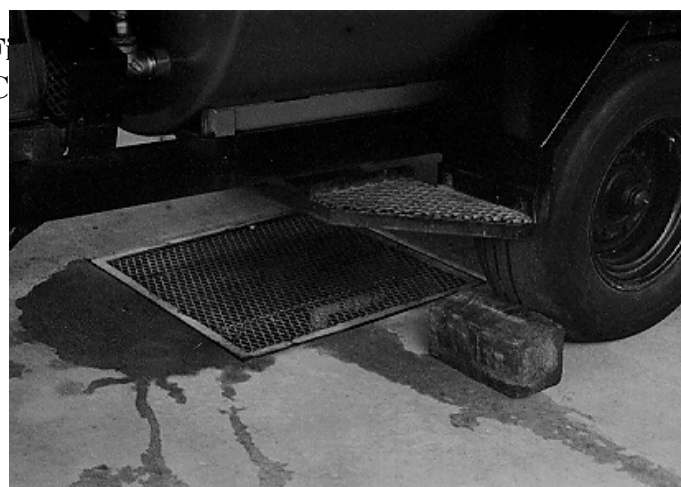
Storage building plans are available from several sources, including the Midwest Plan Service, the University of Florida Institute of Food and Agricultural Sciences (IFAS), and the United States Department of Agriculture-Soil Conservation Service (SCS).

## 1.2 Mixing and Loading

Loading of pesticides and mixing with water or oil dilutents should be done over an impermeable surface (such as lined or sealed concrete) so that spills can be collected and managed. Refer to the DEP publication *D.E.P. Minimum Construction and Operation Standards for Chemical Mixing Centers used for Pesticide Mixing and Loading*. Although use of a chemical mixing center (CMC) is not mandatory, adherence to the standards in the above publication is strongly encouraged.



The purpose of a CMC is to provide a place where the operator can perform all operations where pesticides are likely to be spilled in concentrated form, or where even dilute formulations may be repeatedly spilled in the same area, over an impermeable surface. Such a surface should provide for easy cleaning and recovery of spilled materials. In its most basic form, a CMC is merely a concrete pad treated with a sealant and sloped to a liquid-tight sump where all of the spilled liquids can be recovered. For small spills, absorbents such as cat litter or sand may be used for clean up of the spill and then applied as a top dressing in accordance with the label rates, or disposed of as a waste. Solid materials, of course, can be swept up and reused.



**Figure 3 Spills flow into sump, not onto the ground.**  
Courtesy of John's Island West.

Materials other than concrete, such as tough synthetics, may also be used in some cases. These materials are often used for portable CMCs where a permanent facility is not practicable.

Figures 1 through 4 depict some actual CMCs used at golf courses in Florida. Designs for CMCs are available from several sources including the Midwest Plan Service, USDA-SCS, and IFAS.



**Figure 4 Tanks are used to hold rinsewater until reuse. Note separate H, I, and F tanks. Courtesy of John's Island West.**

***The first principle of CMC management is that any material that collects on the pad must be applied as a pesticide or disposed of as a waste.*** Since any water, including rain, that collects on the pad must be used as a pesticide or disposed of as a waste, a roof with a substantial overhang (minimum 30 degrees) on all sides is strongly recommended to protect against windblown rainfall. In addition, most CMCs will have a provision for pumping out the sump to storage tanks, one for each general type of pesticide (ie. herbicide, insecticide, or fungicide). In this way, spills and rinsate can be saved and used as make-up water for the next time that type of material is applied. *All spills should be cleaned up immediately, and the sump should be pumped dry at the end of each day, or more frequently when materials are changed to something which is incompatible with that previously used.* Provisions should be made to clean the tires and particularly dirty areas of the equipment exterior prior to bringing it into the pad area to minimize a build up of sediment in the sump. Sediments should be removed from the sump any time materials are changed to incompatible types so that the sediments can be applied as a pesticide to the turf at less than the label rate, instead of requiring disposal as a (possibly hazardous) waste.

*It is extremely important to pump out the sump and remove all sediments when changing pesticides in order to avoid disposal problems due to cross-contamination.*

Small spills may also be cleaned up by using an absorbent such as cat litter and then applying the absorbent to the turf as a pesticide in accordance with the label instructions, for example, by mixing with dry fertilizer where permitted by the label. Very small operations may find this method preferable at small mixing areas where hand sprayers are loaded.

***Pesticide containers should be cleaned immediately upon emptying.*** Containers should be properly cleaned by pressure-rinsing or triple-rinsing and the rinse water dumped into the sprayer as part of the make-up water. Non-rigid bags should be shaken clean so that all dust and material falls into the application equipment. The clean containers should be stored in a clean area, out of the rain and weather, until they can be disposed of or recycled. Storing the containers in large plastic bags is one popular option to protect the containers from collecting rainwater. *The cleaned containers should be recycled in counties where such a program is available,* or they may be taken to a landfill for disposal. If you are unable to locate information about pesticide container recycling programs in your area, you may contact the University of Florida Pesticide Information Office at (904)-392-4721

### **1.3 Pesticide Application Equipment Washwater**

Washwater from pesticide application equipment must be managed properly since this washwater will contain pesticide residues. The best management practice for this material is to collect it and use it as a pesticide in accordance with label instructions for that pesticide. This applies to washwater from both the inside and outside of the application equipment. Often, the easiest way to do this is to wash the equipment in the CMC. The pad should be flushed with clean water after washing equipment, and the captured washwater should be pumped into the rinsate storage tank for use in the next application, or it may be applied to the labeled site as a dilute pesticide. The applicator is allowed by the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) section 2(ee) to apply a pesticide at *less* than the labeled rate. *The sump should then be cleaned of any sediment before another type of pesticide is handled.*

#### **1.4 Pesticide Management Summary**

The appropriate practice for the management of pesticide materials depends on the type of material. The proper practice for each type of pesticide material is listed below.

Empty containers	Transport to an approved pesticide container recycling facility after proper cleaning (pressure rinsing or triple rinsing). If no recycling facility is available, after proper cleaning dispose of as solid waste.
Excess formulation	Return to manufacturer, use as a pesticide in accordance with the label, use a hazardous waste contractor to remove and dispose.
Excess mixture	Use as a pesticide in accordance with label.
Material used to contain or collect spills or leaks	Use as a pesticide by applying to a labeled site at <i>or below</i> application rate in accordance with label directions for use. If it is necessary to dispose of the material as a waste, contact the DEP District office for information.
Application equipment washwater	Reuse as a dilutant in subsequent applications. Use as a pesticide by



applying to a labeled site at *or below* application rate in accordance with label directions for use. Alternatively, treat in a permitted treatment facility, such as an evaporation/degradation system. This requires a DEP industrial wastewater permit. Contact the DEP District office for more information.

## **2.0 Solvents and Degreasers**

### **2.1. Storage**

Solvents and degreasers are generally flammable and toxic and should be stored in lockable metal cabinets in an area away from ignition sources and with adequate ventilation. Do not store near an area where welding or other similar activities are performed. Never store with pesticides or fertilizers. An inventory of the solvents stored and the MSDS sheets for these materials should be kept on the premises, but not in the solvent storage area. Any emergency response equipment recommended by the manufacturer of the solvent should be kept accessible to the storage area, but not inside the area itself.

### **2.2. Use**

Solvents and degreasers should be used over a collection basin or pad that can collect all used material. The collected material should be stored in marked containers until it can be recycled or legally disposed of. There are a number of private firms that provide a service that includes solvent wash basins that drain into recovery drums. These drums are then picked up and the contents recycled or properly disposed of. Solvents should never be allowed to drain onto pavement or soil, or discharged into storm drains, sewers or septic systems, even in small amounts. Routine discharge of even small amounts of solvents can result in the accumulation of contaminants in soil or ground water over time, with serious environmental and liability consequences.

### **2.3. Disposal**

Used solvents and degreasers should be collected, placed into containers marked with the contents and the date and then picked up by a service that will properly recycle or dispose of these materials. An IFAS publication, DSP-2, has more information on this.

### **3.0 Fertilizers**

#### **3.1. Storage**

Fertilizers should be stored separately from solvents, fuels, and pesticides since many fertilizers are oxidants and can accelerate a fire. Ideally, fertilizer should be stored in a concrete building with a metal or other-flame resistant roof.

Care must be taken when storing fertilizer to prevent contamination of nearby ground and surface water. Fertilizers should always be stored in an area that is protected from rainfall. Storage of dry bulk materials on a concrete or asphalt pad may be acceptable if the pad is adequately protected from rainfall and from water flowing across the pad. Secondary containment of liquid fertilizer tanks larger than 550 gallons is addressed in 62-762 Florida Administrative Code (F.A.C.). Even where not required, the use of secondary containment is a best management practice.

#### **3.2. Loading**

Areas where fertilizers are loaded into application equipment should be protected from rainfall and spilled material cleaned up immediately. Collected material can be applied to the golf course as a fertilizer. If rainfall protection is not available or practical for the loading area, thorough cleaning is essential. Cleaning of the area can be through dry collection methods such as sweeping or vacuuming, or washing down the loading area.

Any washwater generated would have to be collected and applied to the course. Discharge of this washwater to storm drains or septic systems is illegal.

### **4.0 Grass Clippings**

Grass clippings removed from mowers should be handled separately from other waste materials and equipment washwater. Many manufacturers now recommend the use of compressed air to blow off equipment. This is more protective of hydraulic seals on the equipment, eliminates the washwater, and produces dry clippings that are easy to handle. Another method is to clean mowers over a separate concrete or asphalt pad that allows water to run off onto turf or soil, but not into a surface water body or canal. *The CMC should not be used for this purpose, in order to keep clippings and other debris from becoming contaminated with pesticide residue.* The grass clippings will collect on the pad. After drying on the pad, the clippings can be collected and composted or spread in a wooded area or rough.

## **5.0. Used oil, antifreeze, and lead-acid batteries**

Used oil and antifreeze should be collected in marked containers and offered for recycling. *In Florida, recycling is the only legal option for handling used oil. Antifreeze must be recycled or disposed of as a hazardous waste.* There are commercial services that will collect this material. The IFAS publication DSP-2 has information on this subject.

Lead-acid storage batteries, such as used in golf carts and for starting other equipment, are classified as special wastes and must be recycled. All lead-acid battery retailers are required by law to accept returned batteries for recycling. Used acid from these batteries contains high levels of lead and must be disposed of as hazardous waste, unless contained within a battery being recycled.

## **6.0. Gasoline, Diesel fuel**

Fuel storage tanks should be in compliance with DEP storage tank regulations (Chapter 62-761 F.A.C. for underground tanks and 62-762 F.A.C. for aboveground tanks). Call the nearest DEP District office for information on these requirements. In general, underground tanks with volumes over 110 gallons and above-ground tanks with volumes over 550 gallons must be registered and located within secondary containment systems.

Fuel dispensing areas should be designed and managed to prevent soil and water contamination. Concrete or asphalt surfaces should be provided near the fuel pumps. The pumps should not be located where a spill or leak would cause fuel to flow onto the ground or into a storm drain or surface water body.

Secondary containment structures are required for above-ground fuel tanks over 550 gallons. The best practice is for these structures to be roofed to keep out rainfall. Building the containment structure so that it is tall rather than wide will also help with minimizing rainfall accumulation by reducing the amount of surface area of the structure. If the structure is not roofed, then water that accumulates must be managed properly. *If the structure has a discharge port, make certain that it is closed and locked except when uncontaminated rain water is to be drained. The best option is to have **no***



**Figure 5** Fueling area. Note the continuous curb. Courtesy of John's Island West.

*discharge port and to use a portable sump pump to remove water when it is necessary. A discharge port invites the possibility that it may be left open when a leak occurs.*

The first line of management is to minimize the need to discharge. If the containment volume is adequate, evaporation of accumulated rainfall will often be sufficient. Critical levels at which discharge is considered should be established for each facility and the levels marked on the containment wall. This will prevent frequent and unnecessary discharge of small volumes.

The water to be discharged must always be checked for contamination. This can be done by looking for an oil sheen, observing any smell of fuel or oil, or through the use of commercially available test kits. *Never discharge any water that is contaminated.* Contaminated water must be treated on site using commercially available treatment systems, or discharged to an off-site treatment system directly or by being transported by tanker truck to a treatment facility. Never discharge to a sewer system without written permission from the utility. For more information on treatment options, contact the appropriate DEP District office.



**Figure 6** Fueling and general equipment wash station. Courtesy of Collier's Reserve.

If the water is not contaminated, it can be discharged to a stormwater system, retention area, or grassed swale. Do not discharge it during a rain event, since the added flow may cause it to run-off to a sensitive area.

## **7.0. General Equipment Washing**

Washwater generated from the cleaning of equipment other than pesticide application equipment does not have to be collected and applied to the course. This washwater must not, however, be discharged to surface water either directly or through ditches, storm drains or canals. Equipment washwater can contain soaps, fertilizer residues, solids, and lubricating oil residues. This washwater should not contain solvents and degreasers. These materials should be used in a separate operation. See section 2.0 above for information on solvents and degreasers.

BMPs for washwater from other than pesticide application equipment depend on the quantity generated. If quantities less than 500 gallons per day are generated, the DEP District office may allow the washwater to drain to a grassed retention area or swale, as long as no direct contact with a surface water body occurs. Discharge to a septic system is not legal.



**Figure 0** Wash water recycling system. Courtesy of Collier's Reserve.

For larger quantities, the options are:

- ✂ use of a washwater recycling system, or
- ✂ discharge to a treatment system that has been permitted under DEP industrial wastewater rules, or
- ✂ discharge to a domestic sewer system (with written permission from the utility).

If you decide to use a wash water recycling system, care must be taken to operate it properly. *Do not clean pesticide application equipment using these systems.* The introduction of pesticide residues into these systems can result in contamination of the systems and high costs for disposal of contaminated filters and sludges.

If you generate more than 100 gallons per day, you should contact the DEP District Office that is responsible for your area. In many cases, the District office will allow discharges up to 500 gallons per day without a permit provided that the washwater is not going to a surface water body or other sensitive area.

For all quantities generated, the amount of detergents used should be minimized. The amount of water used to clean equipment can be minimized by using spray nozzles that generate high pressure streams of water using low volumes.

Oil/water separators can be used, but must be managed properly to avoid problems. First, *do not wash equipment used to apply pesticides on pads using oil/water separators*, since the pesticide residues will contaminate the oil that is salvaged. Second, be aware that the oil collected in these systems may be classified as a

hazardous waste, depending on its composition, making disposal expensive. Oil water separators are not necessary unless the water from the system is to be reclaimed for some particular end use, or large volumes of water are generated and the industrial wastewater permit or receiving utility requires such a system.

## **8.0 Equipment Storage**

Equipment used to apply pesticides and fertilizers should be stored in an area protected from rainfall. Rain can wash pesticide and fertilizer residues from the exterior of this equipment and these residues can contaminate soil or water. Pesticide application equipment can be stored in the Chemical Mixing Center, but fertilizer application equipment should be stored separately.

## **9.0 Summary**

<b>Material or Activity to be Managed</b>	<b>Best Management Practice</b>
Pesticide Mixing and Loading	Chemical Mixing Center and proper operation and maintenance. See summary in section 1.4.
Solvents from equipment washing	Separate solvent collection systems such as solvent wash baths.
Soaps, other non-solvent materials used to wash equipment, oils washed off of vehicles	For less than 500 gallons per day - Washwater areas that allow water to seep into grassed retention areas or swales not connected to surface water. For more than 500 gallons per day - Industrial wastewater treatment system, water recycling systems (provided no pesticide residues enter system), or, with written permission, hook-ups to waste water treatment plants.
Fertilizer storage	Covered fertilizer storage areas with curbs or berms to prevent water from entering. Secondary containment should be used even where not required.
Pesticide storage	Covered, locking concrete or steel buildings with adequate ventilation and metal shelving, no floor drains, and a berm or sill to contain spills.
Used oil, antifreeze	Collection and recycling.

Gasoline, diesel fuel

Compliance with DEP regulations for above-ground and below-ground tanks, closing of stormwater drains in immediate vicinity of fueling point.



### **Additional Sources of Information**

Agricultural Engineering Department, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, Florida, 32611. Phone: (904)-392-2468.

Audubon Society of New York State, Inc. 46 Rarick Road, Selkirk, NY 12158. Phone: (518)-767-9051

Florida Department of Environmental Protection, Agricultural Source and Water Well Management Section, MS-3515, 2600 Blair Stone Rd., Tallahassee, Florida, 32399-2400. Phone: (904)-488-3601.

Golf Course Superintendents Association of America. 1421 Research Park Drive, Lawrence, KS 66049 Phone: (913)-841-2240.

Midwest Plan Service, 122 Davidson Hall, Iowa State University, Ames Iowa 50011-3080. Phone: (515)-294-4337.

Pesticide Information Office, University of Florida Institute of Food and Agricultural Sciences, Gainesville, Florida, 32611. Phone (904)-392-4721

University of Florida Institute of Food and Agricultural Sciences, Palm Beach County Cooperative Extension Service. 2976 State Road 15, Belle Glade, FL 33430. Phone: (407)-996-1655.

United States Department of Agriculture-Soil Conservation Service. P.O. Box 141510, Gainesville, FL 32605. Phone: (904)-338-9555.

United States Golf Association, P.O. Box 708, Far Hills, NJ 07931. Phone: (908)-234-2300

### **Publications**

Audubon Cooperative Sanctuary Program for Golf Courses. Audubon Society of New York State, Inc. 46 Rarick Road, Selkirk, NY 12158. Phone: (518)-767-9051

Designing Facilities for Pesticide and Fertilizer Containment. MWPS-37. MidWest Plan Service.

Disposal Options for Agricultural Wastes. DSP-2. IFAS Palm Beach County Cooperative Extension Service.

Conference Proceedings from the National Symposium on Pesticide and Fertilizer Containment: Design and Management. MWPS-C1. MidWest Plan Service.

Conference Proceedings from the National Symposium on Pesticide and Fertilizer Containment: Design and Management 2. MWPS-C2. MidWest Plan Service.

Minimum Construction and Operation Standards for Chemical Mixing Centers used for Pesticide Mixing and Loading. Florida Department of Environmental Protection, Agricultural Source and Water Well Management Section

### **FDEP District Offices**

Northwest (Pensacola) (904)-444-8300

Northeast (Jacksonville) (904)-448-4300

Central (Orlando) (407)-325-2290

Southeast (W. Palm Beach) (407)-433-2650

Southwest (Tampa) (813)-744-6100

South (Ft. Myers) (813)-332-6975

FDEP Agricultural Source and  
Water Well Management Section  
(Tallahassee) (904)-488-3601

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